

Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 45

OBAKAMIGA LAKE AREA

(NTS 42 F/SW)

Districts of Algoma and Thunder Bay

by

John F. Gartner and D.F. McQuay

1980



Ontario

Ministry of
Natural
Resources



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MAP (accompanying report)

Map 5084 (coloured) - Northern Ontario Engineering Geology Terrain Study,
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1:100 000.



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John F. Gartner¹ and D.F. McQuay²

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Obakamiga Lake area, Districts of Algoma and Thunder Bay. The area, which covers NTS block 42F/SW, lies between Latitudes 49°00'N and 49°30'N and Longitudes 85°00'W and 86°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km² of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5084, accompanying this report).

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Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common format for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

The map area is underlain by rugged rocks of Early Precambrian age. Bedrock exposures are abundant. Bedrock in the northern half of the area consists mainly of migmatitic metasediments and minor metavolcanics, with a large belt of metavolcanics and metasediments extending 30 km west from the eastern boundary of the area and several small belts of metasediments scattered throughout. The southern part of the area is underlain mainly by felsic igneous and metamorphic rocks. There is a sizeable belt of metavolcanics and metasediments (including iron formation) around Manitouwadge and several small belts of metavolcanics and/or metasediments scattered throughout this part of the area (Ayres *et al.* 1971; Milne *et al.* 1972).

Mining of copper, lead, and zinc is presently being carried out in the Manitouwadge area, resulting in the production of about 5,000 tons of ore per day (Town of Manitouwadge, personal communication). The metavolcanic-metasedimentary belt around Manitouwadge has high to medium mineral potential, particularly for base metals, gold, and silver; the other metavolcanic-metasedimentary belts have medium potential.

The mineral potential of remainder of the area, underlain by migmatites and felsic intrusive and metamorphic rocks, is rated as "least" to unknown (Springer 1978).

2.2 QUATERNARY:

The Laurentide ice sheet advanced from the northeast and deposited a thin, discontinuous veneer of ground moraine over the bedrock. This drift is often less than 1 m thick, increasing to about 5 m or more on the flanks of some of the bedrock hills. Near White Otter Lake in the north-central part of the map-area, a series of kames marks the location of a recessional moraine (Boissonneau 1965). Here, the overburden may reach thicknesses of 30 m or more.

The glaciolacustrine sediments found in the valleys of the White Otter River, Nama Creek, and Macutagon Creek were probably deposited in Glacial Lakes Post-Minong and Houghton. These were early stage glacial lakes that occupied the Lake Superior basin approximately 9 000 years ago (Boissonneau 1966). As the ice front retreated further to the north, the northeastern part of the map-area was inundated by Glacial Lake Barlow-Ojibway, resulting in deposition of further glaciolacustrine clay and silt.

During deglaciation, glaciofluvial processes resulted in the deposition of southwesterly-trending eskers and valley trains, which follow a number of the major river valleys.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK:

3.1.1 Description:

Bedrock knob (RN) landforms comprise the dominant terrain unit in the Obakamiga Lake area. Bedrock outcrops are abundant, and overburden consists of a discontinuous layer of glacial till that is usually less than 1 m thick. However, on the sides of some of the bedrock hills, and in the low areas between these hills, the overburden can thicken to as much as 5 m.

The till has a silty sand texture and contains a high percentage of stones, cobbles, and boulders. In fact, boulders are present over much of the ground surface. The till materials appear to have been reworked and modified in some areas by meltwaters subsequent to deposition. Evidence of this reworking is provided by thin, stratified deposits of silt, sand, and gravel.

Swamps are commonly found in low, stagnant areas between bedrock hills. These organic deposits form a subordinate landform in the predominantly bedrock knob terrain.

A typical symbol depicting this terrain unit is:

$$\frac{RN(tMG,pOT)}{Mn-D(M)}$$

This indicates that the dominant landform is bedrock knobs which have moderate relief, knobby topography, and dry surface drainage. There are subordinate amounts of ground moraine till and peaty organic terrain. Bedrock is the significant landform from an engineering viewpoint.

3.1.2 Significance:

RESOURCES: Portions of the rock can be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Ground water resources within the rock will be limited to fractures, faults, and fissures. The occurrence of aquifers is unpredictable and the terrain has only poor potential for ground water supplies.

GENERAL CONSTRUCTION: The major constraints in terms of construction are the presence of irregular and complex bedrock outcrops and large boulders on the ground surface. This means that below-ground excavations will require blasting.

Site-grading will be expensive and rock fills will be necessary in grading works. Foundation conditions should be excellent on the bedrock, but route alignments will require rock cut-and-fill operations.

Because of the shallow drift cover and complex bedrock slopes, development activities are generally more difficult, and hence more expensive, than in areas of thicker overburden. Management of the land for any development would be complex. The variable and steep rock slopes, combined with the shallow overburden, will make the terrain sensitive to surface erosion, especially when cleared of vegetation.

WASTE DISPOSAL: The bedrock terrain is not amenable, in its natural state, to the disposal of waste, whether it be garbage, septic tank effluent, or industrial liquid waste. Development of lagoons or tile fields would require extensive grading of rock materials and importation of suitable soil fill. Fractures in the bedrock could act as conduits for migration of effluents, and the impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground Moraine (MG) occurs either as a subordinate unit in conjunction with the bedrock knob terrain, as previously discussed, or as a dominant unit in the form of a thicker veneer over the bedrock. The latter situation is represented by the green colour on the Data Base Map (OGS Map 5084, accompanying this report).

Where the moraine is dominant, it forms a 2 to 5 m thick mantle overlying the bedrock. The unit consists of stony, cobbly, and bouldery silty sand till. Much of this ground moraine has been inundated in the past by glacial lakes and meltwaters, producing a washed and modified surface throughout much of the area. Thus, it is possible to find thin layers of stratified sand, silt and, in some cases, gravel overlying and intermixed with the glacial till material.

A typical symbol depicting this terrain unit is:

tMG/R(pOT,RN,smLP)
Lunw-D(M)

This indicates a variable, but generally thin, mantle of ground moraine overlying the bedrock. The significance here is that, although the underlying bedrock controls the relief, the ground moraine is thick enough to be considered the dominant material from an engineering standpoint. Subordinate amounts of silty sand lake plain deposits, organic terrain, and rock knobs can be expected within this terrain unit. The terrain has undulating low relief with occasional knobs and has been reworked by glacial meltwaters. The ground moraine is dry, while the subordinate landforms are mixed wet and dry.

Grant (1968) described a fine-grained, highly calcareous till of predominantly Paleozoic lithology, which forms a thin veneer over much of the bedrock in the Manitouwadge area. He indicated that this till was observed over a considerable area, but was indistinguishable 40 km south of Manitouwadge.

3.2.2 Significance:

RESOURCES: Sand and gravel resources are scarce within the morainal landforms. Small pockets of stratified sand and gravel may occur where glacial meltwaters and lake waters have reworked the till. However, these deposits would be extremely small in size and their locations would be difficult to predict.

Ground water resources for water supply purposes are not expected to be significant. The ground moraine unit is generally too thin to provide good aquifer conditions.

GENERAL CONSTRUCTION: Because the glacial till is bouldery and often forms only a thin veneer over bedrock, there will be a number of construction problems, particularly in connection with rock excavation and grading. Excavations, except for very shallow ones, can be expected to intersect bedrock and zones of very bouldery soil.

However, the till should be reusable as fill and foundation conditions should be adequate for normal structures.

WASTE DISPOSAL: The bouldery nature of the overburden and the existence of bedrock near the surface put constraints on the location of waste disposal facilities. The successful siting of lagoons and landfills

will depend, to a great extent, on the thickness of till overlying the bedrock. Septic systems are likely feasible in many localities, but detailed investigations of local conditions are required in all cases.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

A *kame moraine* (GK) was identified around White Otter Lake in the north-central part of the map-area. The symbol depicting this terrain unit is:

$$\frac{\text{sgGK}(\text{sgGE})}{\text{Lnk-D}}$$

The dominant landforms in the unit are the kames, which are composed of sand and gravel. Subordinate ridges occurring within the unit also contain sand and gravel. A sample taken from one of the eskers contained 58% gravel, 41% sand, and 1% silt. This indicates a fairly coarse material that is likely suitable as a crushing source for aggregate. The unit has low knobby relief and includes some kettle holes. Surface drainage conditions are dry. This kame moraine correlates with the White Otter Lake moraine mapped by Boissonneau (1965).

Eskers (GE, >>>>>>>>>) have been identified in a number of localities throughout the area. These landforms occur as ridges that are generally less than 10 m in height. However, in the northwestern part of the area, a substantial north-trending esker complex crosses the White Otter River. This unit is about 25 m in length, consists of ridges and kettles, and generally has relief of less than 15 to 20 m. A sample of the material in the esker ridges, taken from the northern part of the feature, consisted of 55% gravel and 45% sand. The complex appears to have been modified by glaciolacustrine action, since deposits of silty sand are common on the flanks of the esker ridges. An occasional rock knob protrudes through the landform. This particular terrain unit is depicted by the symbol:

$$\frac{\text{sgGE}(\text{RN})}{\text{Luk-D}}$$

A major esker-outwash complex follows the Gum River in the south-central part of the map-area. Here the landform is not so massive as in the case of the previously described unit and is shown on the Data Base Map (OGS Map 5084, accompanying this report) by the symbol:

$$\frac{\text{sgGE,sGO/R(RN,pOT)}}{\text{Lupk-D(M)}}$$

The esker ridges are shown by chevrons (>>>>>>>>>) on the map and the outwash forms a thin blanket over the bedrock flanking these ridges. In some areas, drainage is poor and the outwash is covered by organic terrain. Bedrock knobs can be expected.

Outwash (GO) occurs as the dominant landform in Nickle and Herbert Townships, northeast of Manitouwadge. The unit is represented by the symbol:

$$\frac{\text{sGO(sGO/LP/R,RN)}}{\text{Lptk-D}}$$

This indicates that sandy glacial outwash is the dominant landform. Subordinate to this, but occurring commonly throughout the unit, is a sequence of sandy outwash material overlying lake plain deposits which in turn overlie bedrock. Rock knobs are also evident. The thickness of the sediments overlying the bedrock is probably no more than 5 to 10 m.

Outwash also occurs in association with many of the lake plain deposits and as a thin veneer over many of the till deposits. Fenwick (1967) described some of these outwash plains as small sand plains characterized by small straight pines and spruce and by a lack of underbrush.

3.3.2 Significance:

RESOURCES: The most extensive sand and gravel resources are to be found in the esker complex in the northwestern part of the area and in the kame moraine near White Otter Lake in the north-central part. Materials in these terrain units consist of sand and gravel, and there is potential for crushable aggregate. Aggregate materials can also be found in many of the other esker ridges which occur throughout the area. Materials in the

associated outwash deposits are predominantly sandy in texture and do not possess the resource potential of the esker and kame materials.

Ground water supplies may exist at depth in the esker complex and the kame moraine. However, ground water potential is poor in the other landforms, mainly because of their low and variable thickness over bedrock.

GENERAL CONSTRUCTION: The following general comments describe the construction suitability of the various glaciofluvial landforms.

White Otter Lake Kame Moraine: The landforms within this unit consist of knobby kame hills and esker ridges. Conditions here are suitable for most types of construction, but bouldery soils might cause local problems in earth-grading. Excavations should not encounter serious problems and the material can be reused as fill and compacted with normal equipment. The material which will be encountered ranges from very bouldery soil to gravel, sand and, in some cases, silt. Thus, strict construction control is essential when working in this terrain unit.

White Otter River Esker Complex: This unit has generally suitable construction characteristics. However, parts of the complex are intermingled with fine glaciolacustrine sediments which could cause handling problems, particularly during periods of wet weather. Other problems are associated with occasional bedrock knobs, which would require blasting, and the existence of boulders.

Other Glaciofluvial Landforms: One of the main problems associated with construction in these deposits, which are scattered throughout the map-area, is the presence of bedrock close to the surface. This means that deep excavations may require blasting. In some areas, ground water may be close to the surface, thus necessitating dewatering of excavations. Detailed investigations are required before any construction is undertaken.

WASTE DISPOSAL: The disposal of solid and liquid wastes must be approached with considerable caution because of (1) the permeable nature of these soils, (2) the possibility of connection between ground water and surface water, and (3) in some cases, the proximity of bedrock to the surface. Septic systems, if properly designed, should function satisfactorily. However, detailed hydrogeological investigations are recommended prior to construction of any waste disposal facility.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine plains (LP) occur in many parts of the Obakamiga Lake area. In the northeastern corner, these lake plain deposits were probably laid down in Glacial Lake Barlow-Ojibway. The sediments along the major river valleys throughout the remainder of the map-area, and particularly in the southern and western parts, were probably deposited in Glacial Lakes Houghton or Post-Minong.

These deposits are typically variable and complex. A stratigraphic section might comprise from bottom to top: bedrock, variable stratum of till, glaciolacustrine silt and clay, and occasionally stratified fine sand and silt. The full sequence occurs in some areas, while only portions of it are present in others. This results in a very complicated map-unit which reflects a complex geologic origin. A sample taken along the White Otter River in the northern part of the map-area contained 8% sand, 89% silt, and 3% clay. Milne (1968) has described the varved silt and clay which occur beneath bedded sand in the valleys of Nama Creek and the Macutagon River.

Glaciolacustrine sediments in the north-eastern part of the map-area are often associated with organic terrain, resulting in poor surface drainage conditions. These organic deposits may be thick in places, but generally form only a thin layer over the bedrock. A typical map symbol depicting this situation is:

$$\frac{\text{smLP,pOT/R(tMG,RN)}}{\text{Lun-M}}$$

In contrast to these wet conditions, the lake plain deposits found in the river valleys to the southwest are better drained, and can reach thicknesses of over 30 m. Stratigraphy in these areas can be very complex, as indicated by water well logs from the Manitouwadge area. Here, up to 27 m of mixed clay, silt, sand, and gravel, containing stones and boulders, have been intersected in various water wells. The major landforms in the area are illustrated by the symbol

$$\frac{\text{smLP/RN,pOT)}}{\text{Lpu-D(M)}}$$

Therefore, within the silt and sand lake plain deposits, some bedrock knobs and areas of poorly drained organic soils will be encountered. A discontinuous veneer of stratified fine sand and gravel, possibly of outwash origin, overlies the glaciolacustrine sequence in places, thus adding to the stratigraphic complexity.

3.4.2 Significance:

RESOURCES: These glaciolacustrine sediments have little resource potential with respect to sand and gravel. However, because of the complex stratigraphy previously described, there is potential for the development of some local aggregate deposits. A good example of this is the pits which have been developed in the Manitouwadge area.

Ground water resources are generally scarce within the silt and clay strata, but aquifers might occur at depth beneath the clay, especially if sand and gravel overlie the bedrock.

GENERAL CONSTRUCTION: Because the glaciolacustrine soils are basically fine grained, with high percentages of both silt and clay, construction conditions within the unit are far from ideal. The variability and complexity of the stratigraphy also introduces a number of construction problems. The following conditions can be expected:

1. Slope instability where deep deposits of silt and clay are encountered along river banks or on man-made cuts;
2. Erosion and gulying on exposed slopes, with resultant siltation of drainage courses;
3. Difficulties in earth movement operations and subsequent compaction of fills where silt and clay are the dominant materials and where surface drainage conditions are poor, especially during wet weather;
4. Low bearing strengths for footings and foundations where fine-grained soils are deep; and
5. Frost susceptible soils which could affect pavement design and backfill operations.

WASTE DISPOSAL: Septic tile field designs must contend with impermeable soils and poor drainage conditions. These problems will be less severe in areas where adequate thicknesses of sand overlie the clay. Solid waste disposal facilities may lack suitable fill materials and care must be taken to protect surface waters from contamination. It would be necessary to investigate, in detail, the stratigraphic sequences and ground water regimes at depth. The disposal of liquid wastes in lagoons is possible, but construction could be complicated by the existence of surface sand and poorly drained silty soil.

3.5 ALLUVIAL PLAINS AND ORGANIC TERRAIN:

3.5.1 Description:

Alluvial plains (AP) and *organic terrain (OT)* are not particularly widespread in the Obakamiga Lake area. Alluvial plains border all of the drainage channels, but are only of significant size on a few of the rivers and creeks (e.g. Macutagon Creek, Fran Creek, and the White Otter River).

Where these occur, the terrain is generally flat and prone to flooding. Soils consist of fine-grained silt and sand, often containing peat. A typical symbol depicting this terrain unit would be:

$$\frac{smAP(pOT)}{Lpc-W}$$

Organic terrain is found in association with the lake plain deposits, and usually forms a veneer, approximately 1 m thick, over such deposits. A typical terrain unit symbol is:

$$\frac{pOT/smLP(RN)}{Lp-W}$$

3.5.2 Significance:

These alluvial and organic landforms have poor engineering properties and should be avoided by human activities. They are prone to flooding, contain soft and compressible soils, and are generally unsuitable for any type of development.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table, but which may affect the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE

RESOURCE POTENTIAL	BEDROCK	MORAINAL	GLACIOFLUVIAL		GLACIOLACUSTRINE	ALLUVIAL	ORGANIC
			sgGK(sgGE)	sgO(sGO/LP/R)			
RESOURCE POTENTIAL	Sand & Gravel	RN(tMG,pOT)	tMG/R		smLP(RN,pOT)	smAP	pOT
	Ground Water	Poor	Poor	Fair to Good	Poor	Poor	N/A
	Excavation	Poor	Good	Poor	Poor to Fair	Poor to Fair	Poor
LIGHT CONSTRUCTION CONDITIONS	Foundation	Blasting	Fair to Poor	Fair to Good	Fair	Poor	Poor
	Grading	Excellent	Excellent	Good	Poor	Very Poor	Very Poor
	Material Re-Use	Difficult	Fair	Fair to Good	Poor to Fair	Poor	Very Poor
		Rock Fill	Good	Fair	Poor	Poor	Very Poor
WASTE DISPOSAL SUITABILITY	Septic Systems	Very Poor	Fair	Good	Fair to Good	Very Poor	Very Poor
	Landfill	Poor	Fair to Poor	Fair	Fair	Very Poor	Very Poor
	Lagoons	Very Poor	Fair to Poor	Poor	Fair	Very Poor	Very Poor

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